A masterpiece of planning: *The move of NASA 930*

By Eileen Hawley

Aircraft Operations Heavy Aircraft Maintenance Officer and Flight Engineer Sandy Sloan had the task of figuring out how to move the retired KC-135A from its storage location on the far side of Ellington Field's runways to its new home on Aerospace Boulevard.

Under any conditions, moving a 110,000-pound aircraft is no easy feat. Moving one that has been stripped of its electrical and mechanical systems and needs to traverse an active airfield is a challenge indeed.

"Originally, we estimated the move itself would take about two days," said KC-135 Project Pilot Dave Mumme. "We significantly reduced that estimate. It took four hours." A smiling Sloan quickly responds. "It took five years!"

As early as 1997, JSC and the City of Houston were working as partners to create the permanent monument for NASA 930 at the entrance to Ellington Field, off of Highway 3. With negotiations for the transfer of ownership from NASA to the city complete, it was finally time to move the aircraft.

And, after much planning and preparation, a small group of people clustered around the KC-135 on February 28 and readied themselves and the plane for its final journey.

"This was the real masterpiece of the entire process," said Sloan.

The move involved NASA's Aircraft Operations, personnel from the power and telephone companies, members of the Civil Engineering Squadron of the Texas Air National Guard at Ellington and the Red Horse Squadron from Kelly Air Force Base at San Antonio.

The National Guard provided engineering expertise in advance of the move and muscle power the day of the move.

"We couldn't have done it without them," said Mumme.

Picture the geography of Ellington Field. The plane would have to be towed across runways, past hangars, over curbs and streets, and past telephone poles and electrical wires.

"You can't tow the plane up and down over the curbs on these streets," said Sloan. "The structural stress would simply be too much."

The solution was to create a level path for the aircraft by filling the streets to curb level with crushed gravel. That meant acquiring, pouring and leveling enough crushed gravel to fill the five streets up to curb level – about 4 inches – to give NASA 930 an even ride to its permanent home.

In advance of the plane's move, utility workers temporarily removed traffic signs, laid telephone poles on their sides and moved power lines to accommodate the aircraft's 130-foot-wide wingspan.

The exacting choreography required to move NASA 930 began at Hangar 990, NASA Flight Operations' large aircraft maintenance facility.

Before any motion could occur, volunteers from the Texas Air National Guard placed metal sheets of matting in front of the plane. The matting, which is used by the military to construct temporary airfields, provided the aircraft with a consistent travel surface.

With the tow bar attached to its nose gear, the plane was started on its way.

Over the course of the next four hours, the National Guard volunteers "leap-frogged" in front of the plane, pulling up the matting the plane had just traveled over and placing it in NASA 930's path, essentially building a very short and continually moving airfield for the large airplane to traverse.

"We only had about 25 to 30 feet of these strips," said Sloan. "It was hard work and, by the end of the day, these guys were tired."

Traveling an average of two miles per hour, the aging KC-135 was towed slowly across Ellington Field.

Once NASA 930 and its entourage of safety engineers and support personnel arrived at Aerospace Boulevard, they began the hard work of towing the 55-ton plane up a graded, crushed concrete slope and into its final stopping place. Once the aircraft was atop the slope, a jack was used to lift it up so that strut cradles could be placed under its gears. The slope was dug out from under the aircraft and a crane was used to raise the aircraft's nose up until the aft-mounted strut assembly made contact with its mounting pad and was welded into place.

And so, after hundreds of hours spent in planning, in stripping the old aircraft and reclaiming many of its spare parts, in negotiations with the city, and with the assistance of the Texas Air National Guard and the power and telephone companies, NASA 930 now stands at its new permanent location at the entry to Ellington Field, perennially poised for take-off. ■

Many teams took part in moving NASA 930 to its new home including JSC Aircraft Operations, Texas Air National Guard, the Red Horse Squadron from Kelly Air Force Base in San Antonio, and members of the Houston Airport System staff.

Highlights in the history of NASA 930

By Eileen Hawley

For more than 20 years, NASA 930 flew high over the Gulf of Mexico performing a series of arcs and dives that no doubt looked like some sort of aerial ballet. In the process, critical space hardware was validated for flight, astronauts learned to work in zero-g, and researchers gained valuable insight into the behavior of fluids, flames and mechanics in microgravity.

And now, mounted at the entrance to Ellington Field, this historic aircraft appears permanently poised for take-off. All that remains inside its now empty shell are the memories of those who were there for the more than 58,000 parabolas flown by NASA 930 during its career.

Its chairs, wall coverings, and electrical and mechanical systems have been removed. Small openings, hatches and doors are riveted shut. Its landing gear wheels are locked in place. But the aircraft leaves behind a legacy, playing a unique role in the nation's space program and occupying a place in history.

NASA 930 began its career as an Air Force tanker, rolling off the Boeing Aircraft Company production line in 1959 – the same year the Mercury 7 astronauts were selected. At some point, it was transferred to the Federal Aviation Administration where it performed extensive aircraft pattern work verifying airport information. Its final base of operation for the FAA was Honolulu, Hawaii.

When the aircraft reached its designed service lifetime of 13,000 hours of flight time, it was placed in storage at Tinker Air Force Base. Subsequent fatigue analysis studies, engineering change proposals and Boeing's Aircraft Structural Integrity Program extended the service lifetime of the aircraft, and, in September 1972, the aircraft – known by its serial number 59-1481 – was selected as the fourth KC-135 aircraft for use in the Reduced Gravity Program.

Apollo 13 **Director Ron Howard and KC-135 Flight Engineer Sandy Sloan**

The Reduced Gravity Program actually began at Wright Patterson Air Force Base in 1957. Three piston-engine C-131 aircraft were the first used for zero-g flights.

Two KC-135As and one C-135 followed. NASA 930 became the fourth of the 135-style aircraft to be used in the zero-g program and the first wholly owned and operated by the space agency.

Now out of storage, the aircraft was sent to the Boeing plant in Wichita, Kansas, for required maintenance work. With those repairs complete, the plane was flown back to Tinker Air Force Base for additional zero-g modifications and, on August 15, 1973, was flown to Ellington Field.

Its first zero-g foray took place on September 6, 1973. In the next 20 years, NASA 930 would host a variety of experiments and researchers. From Astronaut Bob Crippen who tested the mobility and performance of EVA suits being designed for use by shuttle astronauts, to researchers gathering information on neurovestibular responses to microgravity, to experiments that validated performance of the shuttle's Orbital Maneuvering System fuel tanks, NASA 930 played a key role in human space flight. The aircraft gained some public popularity in late 1994 and early 1995 as director Ron Howard and the stars of *Apollo 13* visited Ellington Field and filmed key footage for that movie.

NASA 930 flew its final parabola on July 21, 1995. The final flight of NASA 930 inaugurated a new and exciting KC-135 program at JSC, hosting the pilot program of the KC-135 Student Flight Campaign, now in its fifth year.

Retired from flight on July 21, 1995, NASA 930 remained in "flyable storage status" at Ellington Field for more than one year as discussions on its ultimate fate continued.

In 1996, KC-135 flight engineer Sandy Sloan began a "reclamation process," removing equipment and hardware from the plane. "Every time we had a spare hour from our normal duties, I was working with (aviation support contractor) DynCorp to take something off that plane," said Sloan.

Some of the removed parts were taken to the shop, serviced, and certified and now are available for use on its replacement – NASA 931.

And now, after 17,791 hours of flight and 58,236 parabolas, NASA 930 stands proudly at the gates to Ellington Field. Retired after a 20-year career and revered by those who flew it, the old KC-135 is a monument to the historic events in which it played a part and a promise of the future greeting astronauts, students, researchers and guests as they enter Ellington Field. ■